REMARKS

Claims 2-14 are pending in the present application. By this Amendment, the specification and claims 2, 4, 7 and 14 are amended, and new claim 15 is added. Applicant thanks the Examiner for the courtesies extended to Applicant's representatives during the October 3, 2002 interview, the contents of which is incorporated herein. Applicant respectfully requests withdrawal of the rejection, and allowance of the claims.

I. Specification and drawing objections

The Examiner objects to the drawings with respect to claims 2 and 14, and to the specification with respect to claims 7 and 14. As discussed in the October 3, 2002 personal interview and shown in the foregoing amendments, Applicant has amended the claims to overcome those objections. Thus, Applicant respectfully requests withdrawal of the objections.

II. 35 U.S.C. § 112, 1st and 2nd paragraph

Claims 2-7 and 14 stand rejected under 35 U.S.C. § 112, 1st paragraph due to alleged lack of enablement, and claims 2-7 and 14 stand rejected under 35 U.S.C. § 112, 2nd paragraph due to alleged indefiniteness. As discussed in the October 3, 2002 personal interview and shown in the foregoing amendments, Applicant has amended the claims to overcome those rejections.

More specifically with respect to 35 U.S.C. § 112, 1st paragraph, Applicant has amended claim 14 to replace the recitation of "injection device" with "means for simultaneously injecting," which the Examiner agreed would overcome the rejection. Similarly, claim 2 has been amended to overcome the §112, 1st paragraph rejection by removing the portion of the claim

cited in the Office Action, which is properly recited in independent claim 14, from which claim 2 depends. Thus, Applicant respectfully requests withdrawal of the rejections, and submits that the claims are in proper condition.

III. Claims 2-7 and 14 are novel

Claims 2-7 and 14 stand rejected under 35 U.S.C. § 102(b) over the individual application of Mueller (U.S. Patent No. 3,925,982) and Rannie et al. (U.S. Patent No. 5,582,000, hereafter "Rannie"). Applicant respectfully submits that the cited references each fail to disclose all of the claimed combinations of features.

Applicant respectfully submits that Mueller and Rannie both individually fail to disclose generating as many distinct zones of jet separation as there are separation triggering elements from mutually spaced initiation points positioned in the divergent nozzle body, as recited in independent claim 14. Mueller discloses closely spaced holes 120 that generate a fluid shock ring. A continuum is formed akin to that which is produced by a ring slot, using a large number of holes (e.g., 267). In Mueller, jet separation begins at a random point of the fluid shock ring, and is thus unstable.

Allegation

Conversely, the presently claimed invention spaces the injection orifices 5 to avoid creating such a fluid shock ring. The orifices create cones 6, which remerge downstream t form a jet at the exit 8 of the nozzle. As a result, the fluid from a given injection point 8 does not merge downstream with the fluid of an adjacent injection point, but instead merges downstream between the cones 6 that have been initiated by the flow through the injection orifices.

Applicant respectfully submits that Rannie also fails to disclose the claimed features. Applicant also respectfully submits that Rannie does not disclose or even suggest that claimed feature.

Claims 2-7 depend from independent claim 14, and are believed to be allowable for at least the same reasons as discussed with respect to independent claim 14. Additionally, Applicant respectfully submits that the cited references fail to disclose (or even suggest) a distributing device that selectively feeds the injectors as a function of altitude, as recited in dependent claim 7.

Therefore, Applicant respectfully requests withdrawal of the rejections, and allowance of the claims

IV. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Before page 1, 1st paragraph, please insert the following section header:

--BACKGROUND OF THE RELATED ART--

Before page 4, 1st paragraph, please insert the following section header:

--SUMMARY OF THE INVENTION--

Before page 6, 5th paragraph, please insert the following section header:

--BRIEF DESCRIPTION OF THE DRAWINGS--

Before the paragraph bridging pages 6 and 7, please insert the following section header:

--DETAILED DESCRIPTION --

Before the paragraph bridging pages 6-7, please add the following paragraph:

--Figure 3 illustrates injectors at three different locations relative to a throat controlled by a distribution device.--

Please amend page 4, 7th paragraph as follows:

At least one of the aforesaid objects of the present invention is achieved through a rocket engine nozzle comprising a system for controlling jet separation, wherein said control system exhibits a plurality of separation triggering elements arranged in such a way as to generate, from mutually spaced initiation [points]orifices, distinct zones of jet separation, so as to form a three-dimensional separation of the flow.

Please amend page 6, 3rd full paragraph as follows:

The injection [points]orifices of the injector of the external stabilizing device are preferably uniformly distributed over the perimeter of the wall of the nozzle. They are advantageously two in number (diametrically opposed) or three in number (distributed at around 1200 over the perimeter if the nozzle).

Please amend page 7, 2nd full paragraph as follows:

The flow separation which is generated by these orifices 5 (i.e., injection points), does not exhibit axial symmetry, but on the contrary it is three-dimensional. This is because each of the [injection points]orifices 5, represented here as three in number and distributed uniformly at 120^0 around the contour of the body 4 of the nozzle, induces a region of separation 6 of the stream exiting the nozzle. Owing to the determination of a limited number of [injection points]orifices 5 which induce an equal number of separation regions 6, the position of the points of initial separation is not indeterminate and this makes it possible to solve the problem of instability.

Please amend page 7, 3rd full paragraph as follows:

Furthermore, by reason of the uniform distribution of the [injection points]orifices 5 around the circumference of the nozzle body 4 in the plane 7, the resultant of the lateral forces which are exerted on the nozzle and which, in the prior art is unstable, remains close to the axis of the nozzle.

Please amend the paragraph bridging pages 7 and 8 as follows:

In theory, the number of [injection points]orifices 5 could be equal to just 2 so as to make it possible to maintain a symmetric thrust for the nozzle. The number of three [injection points]orifices 5 seems however to be a preferable choice in order to avoid accidental separation of half the nozzle which could arise on ignition.

Please amend page 8, 1st full paragraph as follows:

Moreover, a higher number than three injection points may be envisaged, but this does not afford any appreciable advantage. In any event, the number and the spacing of the [injection points]orifices must be chosen in such a way as to avoid any continuity of jet separation, which would amount in fact to the operating conditions equivalent to that of a uniform ring (see the aforesaid American patent US 3 925 982).

Please amend the paragraph bridging pages 8 and 9 as follows:

The injection orifices 5 which direct a secondary stream radially inward according to the invention create an obstacle to the main jet locally, thereby creating an arc-shaped shock wave in respect of the incident supersonic jet. This arc-shaped shock zone interacts with the boundary layer, in which it creates an increase in pressure just upstream of the [injection point]orifice 5,

thereby inducing local separation of the boundary layer at the points 9. Given that the boundary layer was already under conditions under which it was near to spontaneous separation, the jet of the nozzle cannot reattach itself to the wall of the body 4 and the separation of the boundary layer spreads so as to adopt for each [injection point]orifice 5 a conical configuration as shown by the dashed drawing of the separation regions 6 in Figure 1 The vertex of the cones 6 is constituted by the points 9 of initiation of jet separation. The three [injection points]orifices 5 create, starting from the initiation, points 9, three substantially identical cones 6 which are apt to remerge downstream so as to form an entirely separated jet at the exit 8 of the nozzle.

Please amend page 9, 1st paragraph as follows:

Given that the points of initiation 9 where the jet separations occur are imposed geometrically by the position of the three [injection points]orifices 5, the symmetry of revolution is broken and the points 9 of initiation of the separation are stable over time. The shocks which are created due to the separation of the boundary layer relative to the wall of the body 4 also remain localized and the residual vibrations due to these shocks are of low amplitude, as are the residual unsteady forces.

Please amend page 10, 1st full paragraph as follows:

These gases can be reinjected at a few [points]orifices only into the divergent body 4 of the nozzle to achieve jet separation according to the invention.

Please amend page 10, 2nd full paragraph as follows:

The present invention can be adapted to the Vulcain 2 engine with minimal modifications. It is sufficient to modify the injection ring so that it exhibits for example three [injection points]orifices 5 instead of a uniform distribution of injection. Furthermore, the divergent portion 4 of the nozzle, which currently exhibits for the Vulcain 2 engine an area ratio R equal to 60 for a specific impulse of 433 seconds, could be replaced with a divergent portion exhibiting an area ratio R of the order of 140. The film-based cooling function could be replaced with radiative cooling, by virtue of a carbon/carbon nozzle extension known per se.

Please amend page 10, 3rd full paragraph as follows:

For the Vulcain 2 engine, the value of Psep is of the order of 0.22 bar and the recommended location for siting the [points of injection]orifices 5 is the cross section for which the pressure is equal to 0.4 bar. This corresponds to a Mach number of 4 and an area ratio R of around 26. The location is not very different from the current location of the injection ring. The anticipated increase in the specific impulse is of the order of 12 seconds.

Please amend page 11, 3rd full paragraph as follows:

Another solution is to arrange different [injection points]orifices 5 which are activated in succession in such a way as to optimize the operation of the nozzle at each instant. A solution of this type has already been proposed, but for injection at continuous rings by the aforesaid patent US 3 925 982.

Please amend the paragraph bridging pages 12 and 13 as follows:

The device for stabilization on blast-off is represented in Figure 2. It can be used independently or otherwise of the jet separation device. It implements a plurality of injection tubes 10 parallel or otherwise to the axis of the nozzle and arranged downstream of the nozzle exit 8 and directed toward impact points 12. These tubes 10 propagate fluid jets 11 in counter-current to the main stream, the points of impact 12 of these jets being situated slightly downstream of the throat 3 of the nozzle, for example a distance from the throat 3 equal to 0.1 Dl. These points of impact 12 distributed uniformly at one and the same distance from the throat 3 of the nozzle produce a similar effect to that of the [injection points]<u>orifices</u> 5, with the difference however that the fluid, for example liquid nitrogen, which is projected creates a separation at each point of impact 12 through a mass entrainment effect along the boundary layer. The points of separation of the hot gases of the jet from the nozzle are stable by reason of one existence of the impact points 12. It is advantageous to effect this injection with liquid nitrogen, since the counter-current injection rate may be very high (for example 30 kg/s for each injection point for the Vulcain 2 engine) during the short instant which proves to be necessary. Furthermore, the liquid nitrogen is transformed into gas when it encounters the hot gases originating from the combustion chamber 12, which means that the mass flux thus added artificially helps to reduce the phenomenon of spontaneous separation. Once full thrust has been established, the nitrogen jet no longer penetrates into the body of the nozzle and it no longer has an influence on the operation of the engine. The stabilizing device is a ground-based device which is generally arranged downstream of the exit 8 of the nozzle and which requires no modification of the engine

IN THE CLAIMS:

The claims are amended as follows:

2. (Three times amended) A rocket engine nozzle as clamed in claim [8]14, wherein the separation triggering elements comprise:

injection orifices positioned for injecting fluid through a wall of the nozzle body;

[at least one injection cross section which is disposed substantially perpendicular to the wall of the nozzle body,] and

at least two independent injection orifices being distributed over the perimeter of the wall of the nozzle body, each of the injection [orifice]orifices constituting a discrete separation triggering element [inducing]that induces a distinct zone of jet separation.

4. (Three times amended) A rocket engine nozzle as claimed in claim [8]14, wherein [the nozzle body is conical and] the injection orifices comprise at least two, which are symmetrically positioned around the circumference of said nozzle.

7. (Three times amended) A rocket engine nozzle as claimed in claim 6, [wherein the injection device comprises]said means for simultaneously injecting comprising:

a plurality of injectors situated at different distances from the throat for simultaneously injecting said fluid[,]; and

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a [disturbing]distributing device for selectively feeding said injectors at different cross sectional locations to take into account the variation of said distance of spontaneous separation of the flow as a function of altitude.

14. (Amended) A rocket engine nozzle comprising[;]:

a combustion chamber[,];

a throat; and

a divergent nozzle body downstream of said throat, said nozzle body having an axis and a control system for controlling jet separation of [the]a flow in the nozzle body, said flow being parallel to the axis of the nozzle body,

wherein said control system comprises,

at least two mutually spaced separation triggering elements positioned on at least one injection cross section of the divergent nozzle body that is perpendicular to the nozzle axis, and[,]

[an injection devise]a means for simultaneously injecting fluid through the at least two separation triggering elements of said at least one injection cross section of the divergent nozzle body, wherein said spacing of the separation triggering elements [being]is [such that]sufficient for said injection through the at least two separation triggering elements [generates] to generate as many distinct zones of jet separation as there are separation triggering elements from mutually spaced initiation points positioned in the divergent nozzle body[, distinct zones of jet separation], to form a three-dimensional separation of the flow.

112(1st)

Please add new claim 15.